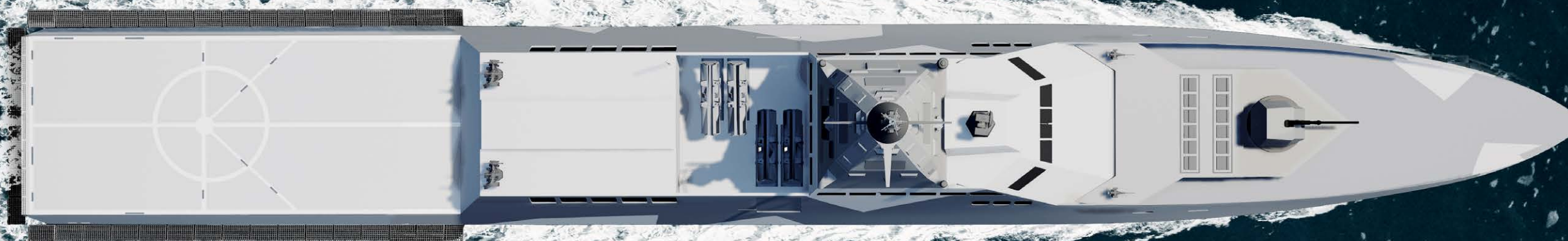


Striking performance

The 9LV Combat System was originally made for operations in the Baltic Sea. Tactically demanding surroundings where you are constantly challenged by a high clutter environment and a military geography that generates large variations and highly compressed tactical cycles. Hence, the 9LV is fast and agile and provides unique capabilities that meet – and often exceed – the needs and requirements of modern naval warfare.



Saab's 9LV offers complete C4I for every type of naval platform, from multi role frigates, large through-deck ships and submarines, to combat- or patrol vessels independent of size.

Designed to excel in combat, 9LV brings you outstanding operational capabilities for all mission types – from the extreme littorals to the open ocean, in all warfare dimensions, manned as well as unmanned.

9LV addresses all resources efficiently. Whether it relates to operational capabilities, availability or economy, you can rely on 9LV to deliver enhanced awareness, faster reaction times and the striking performance required for turning the odds in your favour.

9LV in brief

Saab's 9LV offer comprises everything from complete combat system deliveries to provision of systems and sub-systems, as well as components and services. All operationally proven, reliable and ready for the future, with exceptionally low life cycle costs and designed to suit your needs as well as your platform:

9LV Combat System capabilities

Saab can take the role of Prime Contractor (PC), supplying the platform and a fully integrated combat system. The flexibility of the 9LV Combat System allows you as the customer to select best-of-breed products and components regardless of provider – enabling complete freedom of choice.

Combat management

The **9LV Combat Management System (CMS)** is the command-and-control centre of many advanced surface vessels and submarines. Saab can take full responsibility for the CMS and due to the systems open architecture, Saab can also provide subsets of the CMS modules in partnerships. A full 9LV CMS configuration includes the 9LV Fire Control System (FCS).

Weapon control

The **9LV Fire Control System (FCS)** can also be provided as a stand-alone system, including kill chain components, to any CMS. The FCS configurations range from a single Electro-Optical director and a naval gun to a full multi-dimension weapon control system for an advanced surface combatant. This includes a combination of guns, missiles and decoys with full automation support.

9LV – a naval combat powerhouse

Simplifying complexity

The capability and performance of a modern warship is largely defined by the onboard combat system. This is where Saab and our 9LV Combat System capability can make a difference. With 9LV, Saab can provide a complete C4I solution for any naval platform. A solution that ensures that all the systems in the ship's complex environment work together seamlessly, effectively and consistently.

9LV CS comprises some of the world's most advanced systems and technologies, including weapons and sensors. To simplify the complexity of naval operations, on board a ship, in crowded and confined spaces, under high pressure, where situations can change at a blink of an eye, is – to say the least – a significant challenge.

With more than 250 system deliveries, Saab understand these challenges and the true needs of a modern navy and has become a trusted partner and combat system solutions provider to navies and naval shipbuilding industries around the world.



Champion of the sensor-to-shooter chain

In the marine environment, things often change quickly and without prior warning. It could be a hostile vessel suddenly appearing behind a headland, a flying object spotted on the horizon, or a drone of some kind suddenly approaching. An ordinary day on board turns into a situation where it is vital to immediately understand and take control of the situation, and be first to act. With its unique and rapid sensor-to-shooter chain, 9LV supports all dimensions of naval warfare – air, surface and sub-surface, as well as the internal decision cycle.



Automatic calculation of weapon response

The automated functions of the 9LV Fire Control System (FCS) does not only reduce operator workload in critical conditions, but it also allows the operator to excel in defending their vessel by minimising time of engagement, optimising weapon and sensor usage against multiple threats and enabling rapid and accurate response to any threat.

Rapid response time

In a sharp situation everything is about time, and time is all about being one step ahead of an opponent or a possible threat. Designed to enable ships to effectively deter and counter threats, protect the crew and strike with force, 9LV provides unparalleled response times throughout the sensor-to-shooter chain.

Automatic detection and tracking

The 9LV Track Data Fusion Engine (TDFE) combines sensor data and information into a clear and recognised situational picture. It provides an automated detection and multi sensor tracking capability that gives the operator rapid and reliable situational awareness. And at the same time ease the workload.

Immediate threat evaluation and accurate decision support

Friend or Foe? Bird or drone? Threat or not? Distance, speed, time? When an object appears on the screens, it is vital for the operator to quickly find out what it is and what measures needs to be taken. 9LV is designed to provide instant evaluation of potential threats and give operators the support they need to make fast and accurate decisions.

Combat Management

Unfailing readiness

The **9LV Combat Management System (CMS)** provides the tools for carrying out missions correctly, efficiently and all the way to successful completion. Designed to cope with extremely heavy workloads and multiple tasking, the 9LV CMS ensures unfailing readiness and the striking performance needed for empowering your naval platform and maritime mission.

Reducing operator workload – enhancing effectiveness

Saab's 9LV CMS increases mission capabilities and enables more flexible and effective operations. By utilizing a smart, easy-to-use interface with tailored configurations and highly automated routines it ensures reduced operator workload and greater focus on the most vital tasks at hand.

Built-in support functions

The 9LV CMS is well proven and reliable with support functions as well as operational and technical logging, onboard training (OBT) and built-in-tests (BIT). The 9LV CMS is also able to present operating status on all connected subsystems.

Open architecture

Built with open architecture it enables agile, more affordable upgrades, as well as easy integration of third-party modules. The systems' flexibility also allows any 9LV module to be integrated with equipment from other providers – giving you complete freedom of choice. The adaptable design of 9LV CMS means hardware and software can be adapted to meet specific needs and requirements.

Weapon control

Targeting perfection

In mission critical situations there is no room for error. And here is where the **9LV Fire Control System (FCS)** gives real advantage by providing rapid, reliable response against any threat in any environment. Including advanced high speed or sea-skimming missiles, asymmetric surface threats, as well as drones of any kind.

Highly accurate tracking of air and surface targets and automated threat evaluation, creates a stable situational picture, enables faster reaction times, ensures high precision striking performance and the ability to aim for perfection.

Proven precision

The core components of the 9LV FCS are the combat proven CEROS 200 and the operationally proven EOS 500 directors. Renowned for outstanding precision, both work integral with the other parts of the system to provide a fast and very accurate sensor-to-shooter cycle.

Advanced air defence capability

As well as being fully capable of naval gunfire support and surface defence coordination, the 9LV FCS offer advanced air defence capabilities. Handling multiple incoming targets and tight time constraints sets the system apart from the competition. The 9LV FCS is compact, easy to use and easy to integrate.

Reliable performance

Proven to perform in all environments and conditions, the 9LV FCS is perfectly suited to any vessel – defending its own unit or delivering effect in cooperation with others. The system also provides smart built-in support functions with good fault separation (BIT) which means it is always prepared and ready for action.



Capabilities and configurations

9LV provides complete C4I for all types of naval platforms, from small patrol boats, vessels for security and surveillance, to complex ships like submarines, frigates and through decks.

The cornerstone of a successful Saab naval combat system is the use of 9LV CMS as an enabler. The system development has progressed to an increasing focus on the ability to integrate different equipment to allow for capability growth as well as for configurations adapted to different customer requirements and needs.

Saab have made more than 250 system deliveries to over 20 navies around the world in countries including Sweden, Finland, Norway, Australia and Canada.



9LV CMS – core capabilities

The 9LV CMS technology comprises a range of software and hardware components that are designed to fit together in different configurations to meet the needs of your Navy. All 9LV equipped ships contain a core of components for the I/O interconnections to external equipment, the network and computer infrastructure, including the operator interactive devices and HMI.

A common situational picture

A central feature is to provide a common situational picture. Operators are given a single, clear image of the naval domain, graphically presented with chart or map information and tactical overlays.

AAW and ASuW

Saab is a leading provider, our solutions range from small electro-optical systems controlling a light or medium-calibre naval gun, to large configurations with multiple guns and missile systems. Enabling a high-end engagement chain with rapid reaction times, automated responses, and high precision engagements.

The 9LV CMS comprises the 9LV FCS which reduces the operator's workload in critical conditions by automating threat evaluation, engagement planning and weapon control during engagements.

Features:

- **Coordinates all sensors and weapons**
- **Probability-based evaluation**
- **Cyclic re-evaluation and feedback loop**
- **Quick response to scenario changes**
- **Manual/semi-automatic/fully automatic options**



Surface warfare

A surface-to-surface missile system, like the RBS 15, is a standard addition to 9LV. The combat management system provides information from all available sources to prepare and execute missile assignments. The 9LV situational picture visualises the terrain in littoral environments to assist the operators in finding tactical advantages.

ASW operations

9LV easily integrates functionality and capabilities to participate in or lead anti-submarine warfare operations.

For a small vessel, a subset of sensor or weapon capabilities can be selected, including links for information exchange with other units.

Larger ships benefit from the full 9LV suite of solutions for ASW through a collaborating force of surface, sub-surface and air units.

Decision support

Through an integrated data fusion process the 9LV CMS will establish and maintain a coherent maritime picture and provide a basis for the operator to make informed situation assessments and tactical judgements, based on readiness and priority.

Secure communication

The 9LV integrates to any preferred communication system controlling all your communication technologies regardless of radio band frequency or hardware, reducing risk and increasing operational speed.

One such option is Saab's **TactiCall communication system**, a robust and highly survivable system with no single point of failure. It enables voice and data communication to be controlled from a single user interface, and allows information to be monitored and shared within a multi-level security environment.



Automated tasks

The 9LV CMS generates a picture from both internal and external data inputs, and allows the operator to interact through a selection of modes and to directly intervene with and override commands. Supported by automated situation and anomaly detection functions the operator can focus on tactical decisions.

Secure system environment

The 9LV architecture includes cyber security solutions and support streaming of large amounts of video and recording large amounts of data. It also handles weapon system safety requirements and supports real-time requirements of a critical fire control chain.

Scalable to precise needs

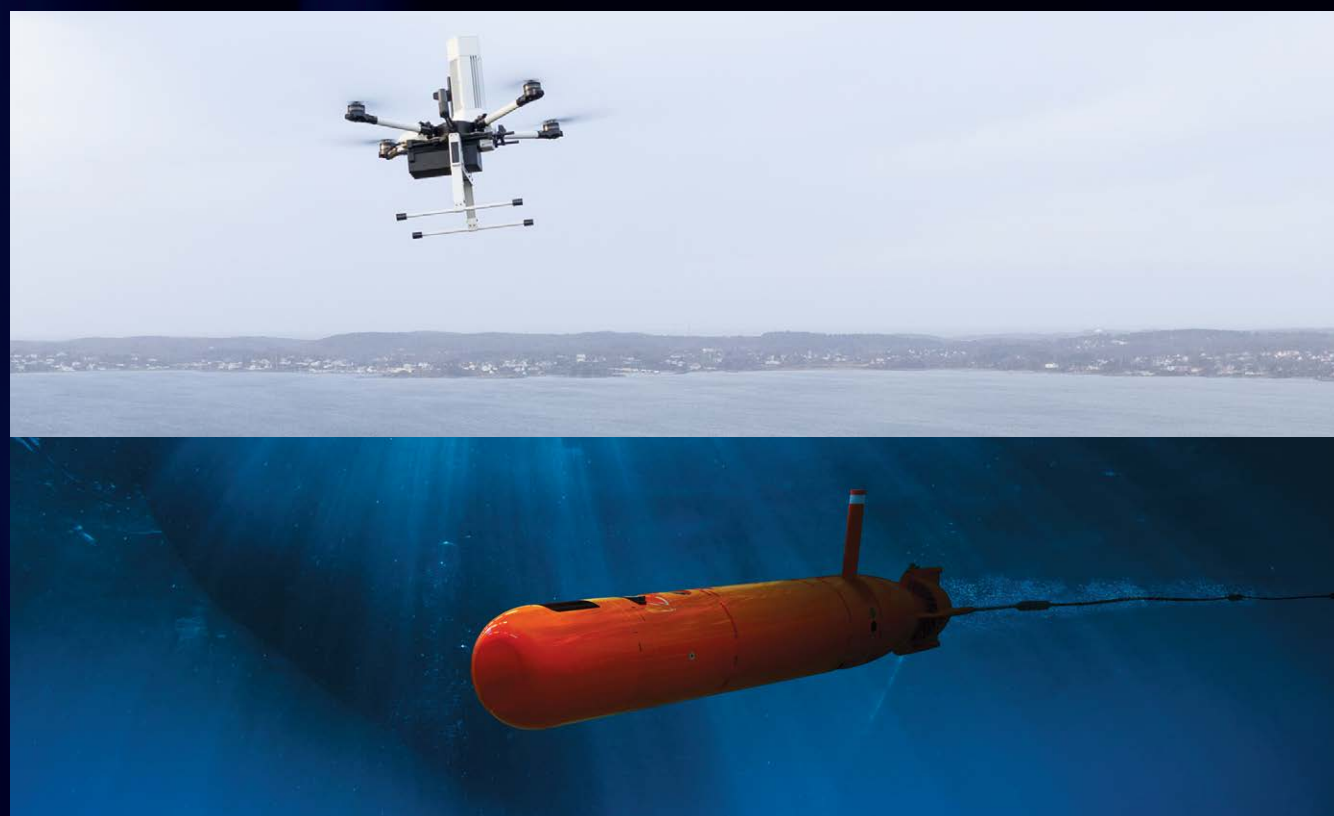
Saab scales each solution to match your vessel's size and capabilities. The 9LV's architecture and hardware infrastructure can handle the demands of a complex frigate or destroyer. It can also be scaled to much smaller ships with special considerations to size, weight and crew limitations.

Future secured

Saab's experience in combining functional modularity with modern computer technology has led to the creation of flexible, scalable solutions with built-in capacity for upgrades and extensions during the entire lifecycle of the ship. Why not talk to us about a regular update program with both security and functionality in mind!

9LV CMS

– extended capabilities



UxV control and optimisation

Unmanned systems give excellent tactical advantages in many situations and naval units will carry several such systems. When more than one unmanned asset is given the same task, coordination and optimization is necessary to bring them to effect and that is where 9LV will give the operator a helping hand. A surveillance task split between a drone and an autonomous vehicle, or a harbour reconnaissance task with the same units – 9LV will assist with the planning and execution of the task – time, distance, endurance, sensor control and coverage considerations will be calculated, weighed and suggested.



» 9LV ensures greater focus on delivering a striking performance.

Ballistic Missile Defence capabilities

The increasing threat of ballistic- and high-speed missiles stresses the need for very capable sensors, weapons and communications. The 9LV CMS will act as a high-performance integration hub to create the effective functional chains necessary for mission success, from detection through threat evaluation to engagements. Datalink feeds will be fused with minimal delay giving command time for decisions and action.



Enhanced video situation awareness

9LV features a video infrastructure that merges and stores input from all IR and TV sensors on-board continuously. Any operator can independently access any part of the video stream at any time. With the right sensors a ship can receive total video coverage, where operators get a stabilized panoramic presentation and the opportunity to zoom in multiple directions simultaneously. Combined with an augmented reality where tactical data is overlaid, the situation awareness will be further enhanced.

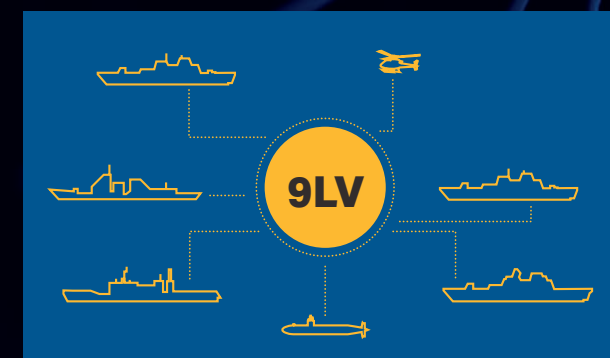


Force networks

Communications are key for task group or task force multipliers. 9LV integrates all standard data links and national derivatives to make best use of the available data flow.

Force functionalities adapt to the information at hand, providing services from data fusion of external sources to collaborative weapon engagements.

The 9LV open architecture enables full usage of future improvements of available communications.



Submarine operations

9LV's advanced sensor and weapon integration ensures optimal performance and subsurface situational awareness to modern submarines and their weapon systems. The 9LV CMS has hardware and software tailored specifically for submarine environments and operational requirements.



Mine Counter Measure (MCM)

The MCM function supports planning, control, analysis and documentation of all MCM-related tasks. Together with the 9LV CMS core functionalities, it provides a comprehensive tool for decision support, command and control. Known information from databases is combined with own sensors or information provided by a task group, through links or other means. The 9LV CMS will integrate any chosen MCM sub-system regardless of provider, manned or unmanned. Self-defence capabilities like AAW or defence against small surface vessels or drones is easily added as these are included in the 9LV core capabilities.



9LV CMS – configurations

The flexibility of the 9LV system makes it possible for you to pick and choose the exact configuration best suited to the vessel. Saab has also created pre-packaged configurations for your convenience. However, these are not stovepipe solutions, and Saab will customise the system to your exact requirements.

Surface combatants

9LV technology can interface many subsystems and be scaled to corvettes, frigates or through-deck vessels. These solutions will typically support many Multi-Function Consoles (MFC's) and meet the demanding needs of battle resilience through extensive redundancy and physical separation of critical assets. Medium-sized configurations often focus on one type of mission, such as anti-submarine warfare (ASW) or anti-surface warfare (ASuW) using surface-to-surface missiles (SSM).

Larger configurations provide a wide range of capabilities and typically include multiple tactical data links and highly automated tactical responses to a range of simultaneous threats, above and below the surface. They also integrate with command support systems to provide the ship with complete C4I capability.



Patrol vessels

Patrol vessel configurations combine full capability with a small footprint. The mix of Multi-Function Consoles (MFCs) and smaller interactive devices is based on the ship's size and operational needs. The communication suite links the ship to any manned or unmanned asset and the recording capabilities are extended to handle the data collected by the ship's sensors. The 9LV's core functionality also include fire control capabilities. A typical set-up, depending on the size of the vessel, is a small or medium-calibre gun integrated with the 9LV. It can be controlled remotely and utilised for both air and surface targets.

A standard configuration could include the MSI Seahawk DS30B, Oto Melara Single 40L70 or BAE Systems Bofors 40 mm MK4. The EOS 500 is a high quality E/O tracking source, providing high accuracy tracking data for ballistic computations and gun-laying for air, surface and littoral land targets. The CEROS 200 features world-class acquisition speed and tracking precision. It can track any low-altitude target, including supersonic missiles and surface threats in any weather conditions over long and short distances.

The surveillance radar can also be used as the solo tracking source for surface engagements. An interface for designation to a Remote Weapon Station with a dedicated console (Saab's Trackfire RWS) can also be provided.



Coast guard, auxiliaries and inshore units

The 9LV meet the demands of smaller platforms, providing powerful capability with a small footprint. It delivers fully integrated situational awareness along with weapon control and C2 capabilities normally restricted to larger, more extensive systems. For the benefit of smaller vessels, Saab can provide hardware for operator interaction and a system infrastructure that can be adapted to the available space, without loss of capability. It is low weight, easy to integrate and cost-efficient throughout its lifecycle.

At its core, 9LV CMS contains hardware that provides the functionality needed for maritime security missions, while it is also uniquely scalable due to full compatibility with all 9LV technology. Communication solutions, video surveillance and designation of threats to a remote weapon station are a few examples of mission requirements.

Submarines

Through our work with 9LV technology and the know-how of our naval platforms specialist Kockums, Saab has vast experience in submarine solutions.

Several generations of 9LV technology have been used for submarine CMS and weapon control configurations. 9LV technology has also been used as the platform for advanced integrated sonar systems with multiple operators and sensors.



9LV FCS

– core capabilities



Speedy response

The CEROS 200 and EOS 500 directors are at the heart of the sensor-to-shooter chain and can be used with any combination of surveillance radar and weapons.

The 9LV FCS is market leading in terms of accuracy and engagement speed with a short reaction time during the designation, search and acquisition phases. Its sensors, pedestal, servo and filtering provide excellent firing performance.

The system is easy to operate using either Saab's proven 9LV Multi-Function Console or any third-party console.



Track-while-scan surface engagements

This capability enables gun firing at surface targets using the ship's surveillance radar as the tracking source. A B-scope picture is used to monitor the engagements and observe firing as well as provide fire corrections.

Accuracy

Both the CEROS 200 and EOS 500 directors provide highly accurate 3D tracking that enables the operator to deal with advanced air and surface threats. Using modern ammunition, every round is a hit, even in complex conditions.

Multiple targets

The 9LV FCS features a range of manual, automatic and semi-automatic modes for controlling sensors and weapons. Along with advanced tracking capability, this allows effective handling of high-pressure, multiple target scenarios.

Naval Gunfire Support (NGS)

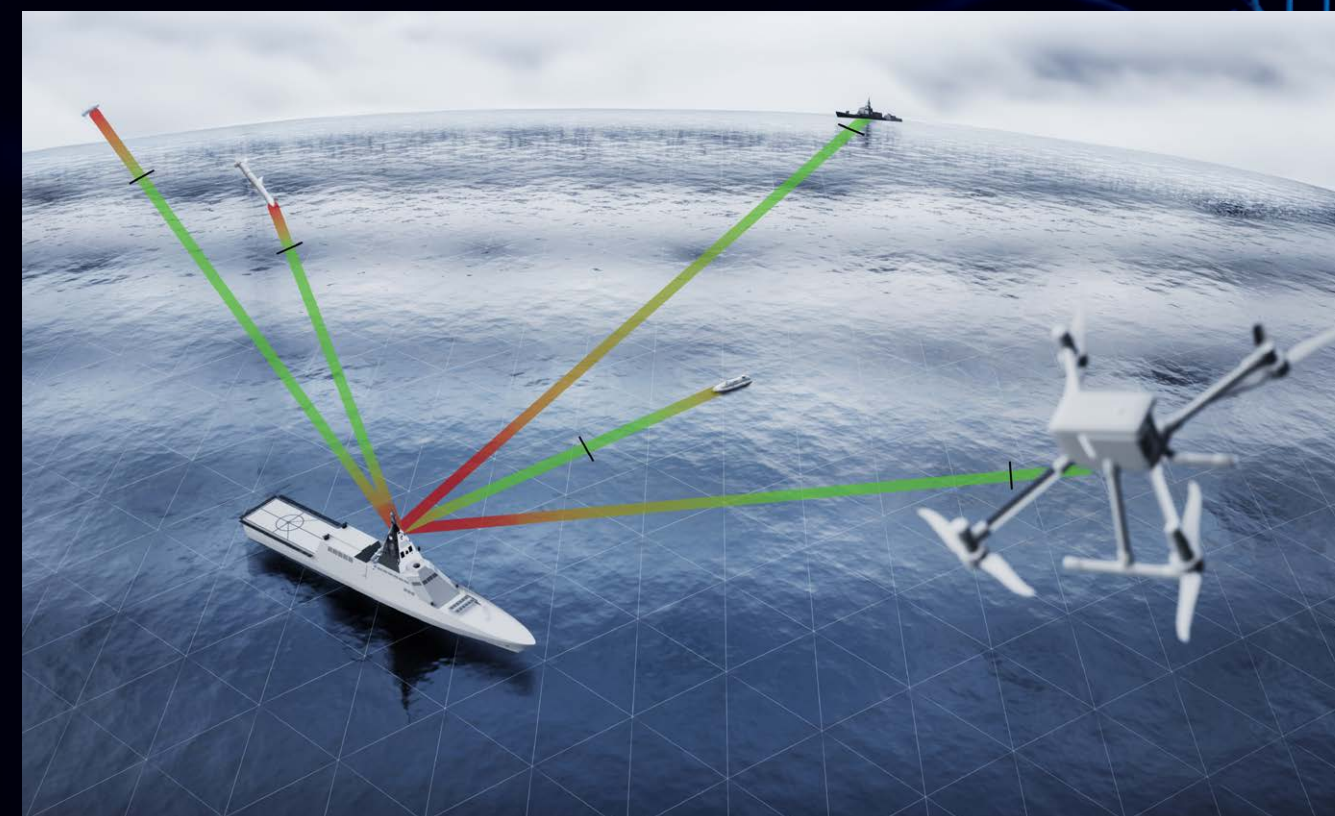
NGS can be used against land targets that are identified by the coordinates in the graphical situational picture. The function supports interaction with a forward observer and provides data for fire corrections.

Reaction time

Both the CEROS and the EOS director will, after designation, track and deliver a firing solution within a very short timeframe. With the use of the built-in system speed, precision and smart filtering, target acquisition and engagement can begin without delay.

Range

The 9LV FCS configurations are designed to meet the requirements of short to long range engagements using a combination of decoys, guns and missiles. The radar director can be used for tracking and target illumination at distances over 100 km.



Air and Surface Defence Coordination (ADC & SDC)

An AAW situation can be challenging when there are multiple incoming targets against a ship or escorted units. The 9LV Air Defence Coordination (ADC) provides solutions that automate and accelerate an optimal response using a ship's AAW defence assets. Saab provide a range of configuration options, from one CEROS director with a medium calibre gun to full optimisation of the ship's guns, SAMs and decoys.

ADC goes beyond traditional threat evaluation and weapon assignment. It considers all available weapons and ammunition in order to calculate and recalculate optimal kill probability, allocating the right weapon, to the right target, every time.

In fully automatic mode, ADC initiates firing very rapidly, only requiring fire permission confirmation from the operators. Along with advanced tracking capability, this allows effective handling of high-pressure, multiple target scenarios. The HMI presents the calculated response on an abstraction level precisely suited for quick reactions in a high pressure environment.

Surface Defence Coordination (SDC) provides an automated defence against directly attacking surface threats, e.g. a swarm attack by high-speed craft. SDC models the ADC way of working, applying automated support to the surface dimension. It allocates the appropriate weapon to a surface target at the right time – making it the most efficient way to counter a direct multiple surface threat attack at short notice.

Operator workload is reduced through automation of the following tasks:

- **Generation and maintenance of a coherent operational picture**
- **Semi-automatic or automatic fusion of available information sources, local or networked**
- **Keeping track of available ADC and SDC onboard and task group resources**
- **Threat evaluation: finding and prioritising threats using all known threat characteristics**
- **Engagement planning: evaluating weapon deployment alternatives and selecting the optimised solution. This is performed cyclically for immediate adaptation to rapidly changing situations**
- **Unambiguous presentation of automated engagements for man on the loop affirmation**
- **Execution control: sending engagement requests to directors, guns, launchers and decoys, as well as sending ship heading recommendations to avoid blind sectors**
- **Task group defence coordination**

9LV FCS – Configurations

Saab is a leading provider of AAW and ASuW solutions, offering anything from small electro-optical systems controlling a light or medium-calibre naval gun, to large configurations with multiple guns, decoys and missiles. Enabling rapid reaction times, automated responses and high precision engagements, Saab provides naval ships with their entire critical self-defence and engagement chain.

Electro-Optical

The Saab EOS 500 Electro-Optical Director with a 30–40 mm naval gun is an ideal solution for surveying a threat environment. The director is used for surveillance, classification, identification and firing solution purposes, as well as for high precision tracking of surface threats, aircraft and UAV's.



Radar and Electro-Optical

This configuration uses the CEROS 200 Radar and Electro-Optical Director to small to medium calibre naval gun.

CEROS enables all-weather capability through its advanced tracking radar. The proximity- or time-fused ammunition of the guns, in combination with the unique precision of the Saab FCS, provides optimum self-defence and engagement capabilities, even against incoming sea-skimming missiles.

For larger ships it is common to fit more than one director and gun to achieve coverage from all directions.



Multi-channel weapon control

Multi-role ships with surface to air missile systems benefit from the 9LV architecture allowing tracking data from all available sensors or links. Decoys, guns, and missiles will be utilised together based on the best probability of effect and advanced automatic defence functionality is provided and integrated with the ESM and ECM capabilities of the ship.

The 9LV Weapon Control System is capable of handling short range SAM's together with longer range area defence SAMs, all of which are supervised and controlled by the 9LV optimising the engagements for the tasks at hand.



We know the ropes

Saab has a history of successful partnerships and leading roles in many naval combat system programmes. We have worked with dedicated partners and sub-suppliers in almost all aspects of naval warfare.

Saab's 9LV Naval Combat System solution combined with a proven track record as a combat system integrator and prime contractor put striking performance within reach for any vessel. In short, we know your challenges and how to get the job done properly.

Upgrade or new-build

Saab is your delivery partner for new and upgraded surface warship and submarine platforms. With our knowledge, skills and professionalism, we can assist you through your product's entire lifecycle – from contributing as a subsystem supplier and integrator to being the Combat System Prime or Prime Contractor.

Providing engineering expertise

9LV is always tailored according to customer requirements to ensure that the correct and necessary engineering expertise is provided during the development and modification of the system.

Skills and experience

Saab provides through-life support solutions ranging from tailored support services to full availability contracts, as well as ongoing technology upgrades required to maintain your operational capability. Saab has skills and experience in all disciplines that are required for the successful delivery of combat systems.

Collaborative approach

All 9LV systems are built on a common, independent technology platform used also for other Saab systems products. The platform provides a powerful virtual development environment with integrated build, test and deployment tools to make the entire development process faster, safer, more secure and cost-effective.

The platform also comprises the security and run-time services that ensure efficient management of hardware, software and cyber security throughout the lifetime of the system. Providing the platform allows for an effective, long-term technology transfer involving the customer nation resources in joint development, maintenance and security of supply.

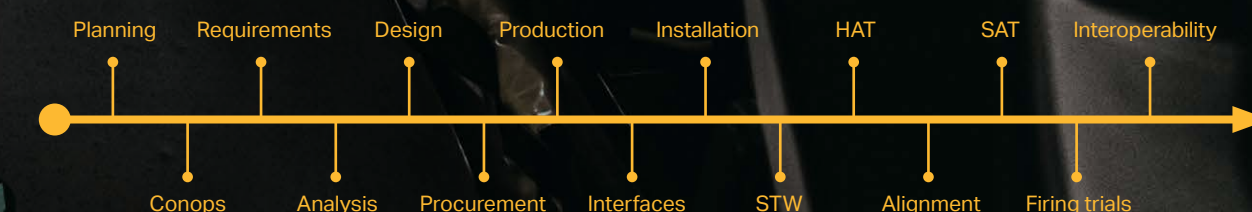
Our engineering competence includes:

- Risk management
- Combat system design
- Subsystem acquisition
- System safety
- Performance engineering
- Logistics Engineering (RAMT – Reliability-Availability-Maintainability-Testability)
- Life Cycle Cost (LCC) Analysis
- Top deck design
- Combat Information Centre design
- Interface engineering
- Platform integration services
- System integration
- EMI/EMC services
- Acceptance testing

AMBITION

REALISATION

VALIDATION



Bringing the pieces together

Risk management is key to a successful delivery of a combat system on time and within budget. Saab has vast knowledge and experience in risk management processes.

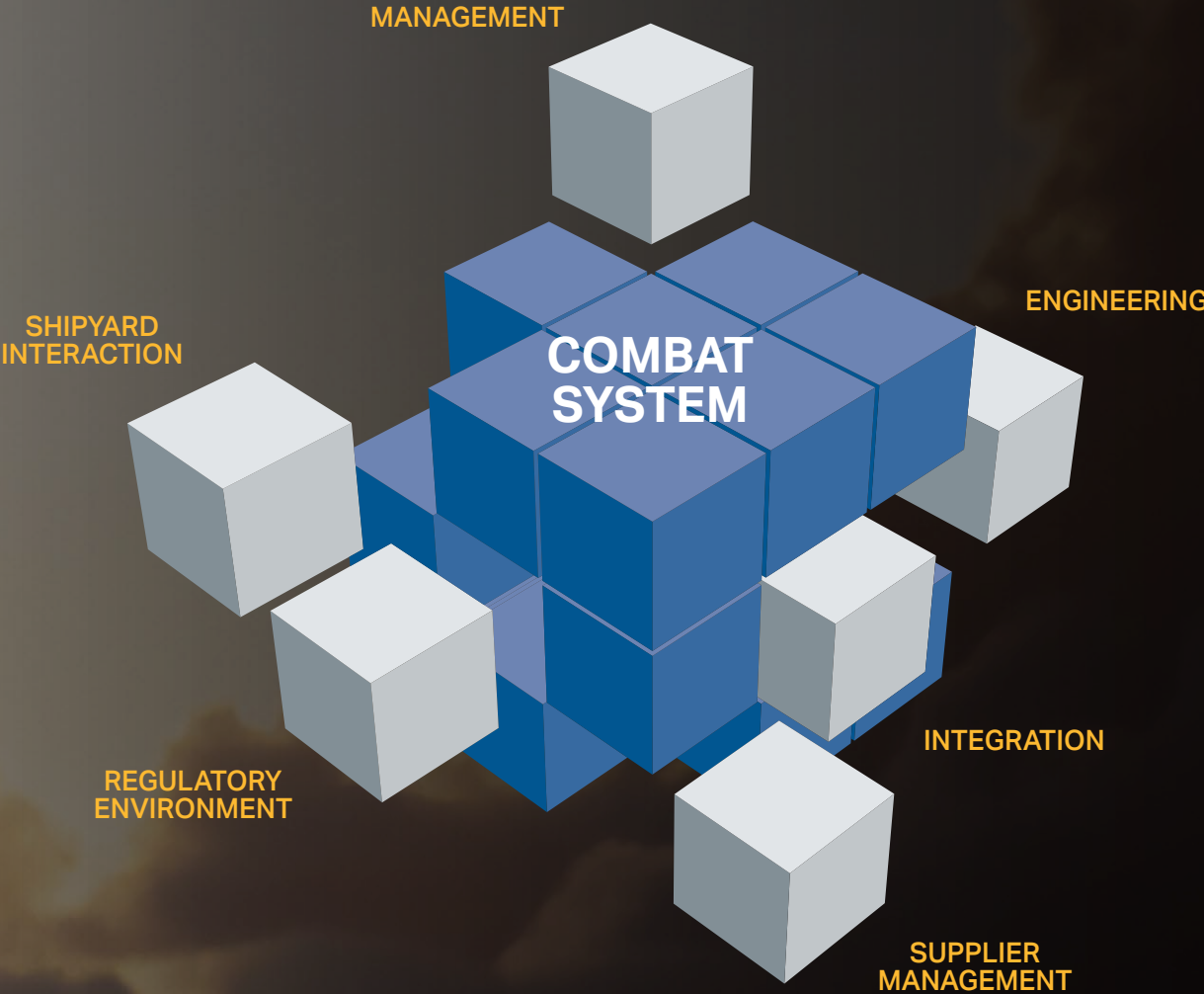
Reliable and efficient process

The 9LV CS process captures this know-how and applies it to each specific project. Risk management requires prior experience and an understanding of the customer's environment, and it is essential for the development of a trusted relationship between Saab and its customers.

Experienced management teams

Managing the development of a combat system for a ship is a significant undertaking. It is, however, much simpler if it is done frequently and builds upon previous programmes or projects. Saab initiates several programmes every year and has multiple ongoing projects. We are able to provide experienced programme/project management teams for work at various levels including platform level modernisation, combat system supply and CMS supply.

The management team oversees the initiation and control of the project. The support provided by the management team will scale with the size of the project. Saab can provide much-needed project management services such as information management, configuration management, quality assurance, work definition, planning and scheduling.



The keys to the successful delivery of a combat system on time and within budget are:

- MANAGEMENT**

 - Establishment of a plan for the entire programme
 - Development of a credible time schedule
 - Management of the programme in accordance with the scope of the plan and schedule requirements
- ENGINEERING**

 - Customer assistance with establishing concept of operation (if required)
 - Customer assistance with establishing the maintenance concept and operational profile for the system
 - Interpretation and analysis of customer needs and lifecycle plan (costs, future capabilities, etc.)
 - Allocation of requirements into verifiable system and sub-system requirements for future tests and verification
- INTEGRATION**

 - Established experience in integration of a wide variety of sensors, weapon systems and communications systems (including tactical data links) with 9LV CMS, 9LV FCS and the platform itself to create the optimum solution for customer requirements
 - Understanding of integration time-scales, processes and trade-offs
- SUPPLIER MANAGEMENT**

 - Contracting experience with a wide variety of suppliers from many countries including the USA
 - Understanding of supplier-specific issues and the legal environment of the supplier
- REGULATORY ENVIRONMENT**

 - Experience in working with various regulatory regimes and requirements
 - Understanding of timescales associated with establishment of legal agreements in the regulatory environment
- SHIPYARD INTERACTION**

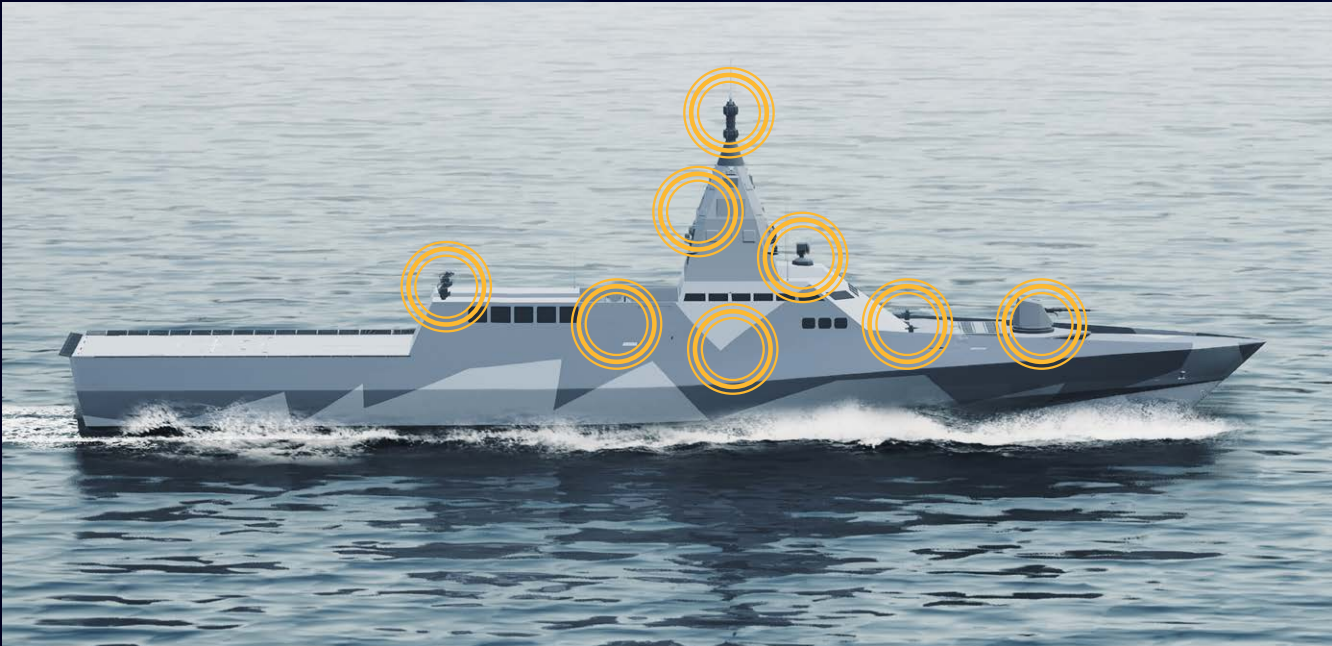
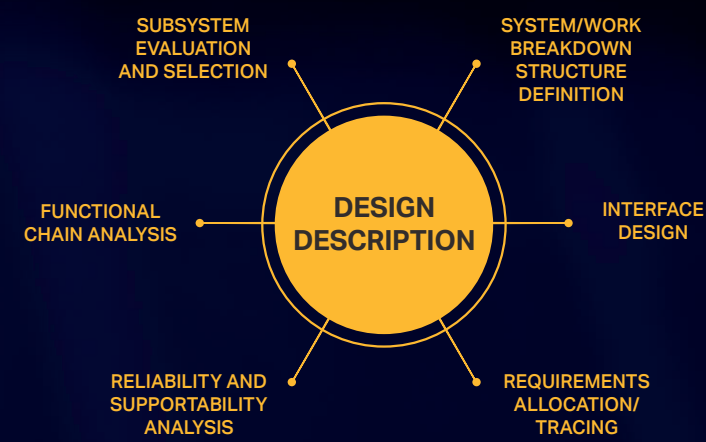
 - Experience with diverse shipyard processes and procedures
 - Understanding of the requirements for information transfer between Saab and the shipyard

Combat System Engineering

Combat System Engineering transforms customer requirements into a realistic and optimised design ready for implementation on the target platform. The production data pack includes purchase specifications for the various elements of the combat system, shipyard manufacturing data packs for mechanical installation and cabling, and test instructions for subsequent system integration and acceptance testing.

Combat System design

Combat System design makes the platform, products and selected subsystems work optimally together with optimal reliability, availability, maintainability and testability characteristics. This is achieved by systematic definition, subsystem selection/proposal, interface engineering and verification.



Subsystem selection

With 9LV CS, customers can select best-of-breed products to suit their needs. Every combat system project has many suppliers at different tiers that needs to be managed during selection, acquisition and production, as well as throughout the integration and testing stages.

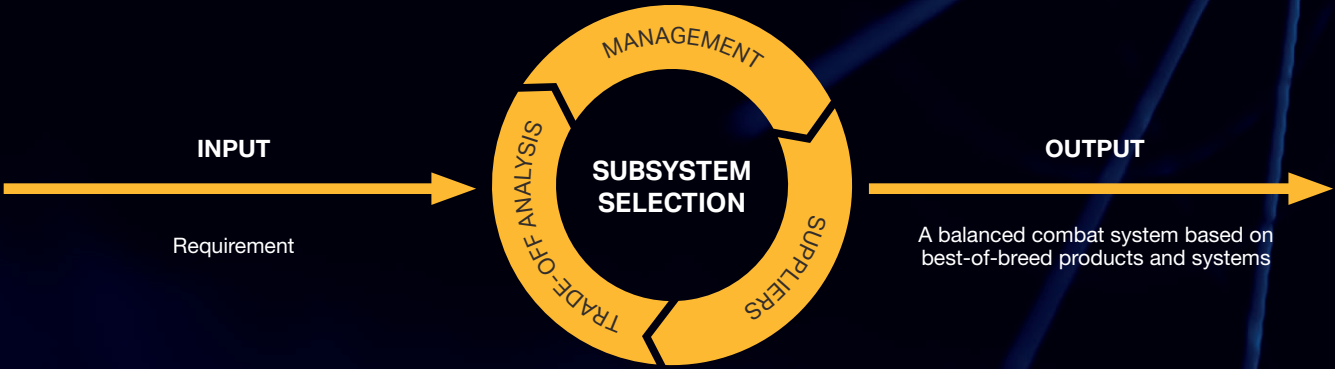
Extensive supplier collaboration experience

Saab has worked with suppliers from many countries and our personnel has the experience and expertise to support the programme or project in the acquisition of, for example, sonar systems, radar systems, FCS, guns, missile systems and UxV's. Specific attention is paid to the requirements of the main supply contract and the analysis, flow down and management of these requirements on the selected subcontractors.

Close monitoring of supplier performance is required throughout the complete project or programme – from initial supplier evaluation to post-delivery warranty and support.

These activities typically involve:

- Selection of subsystem suppliers
- Trade-off analysis
- Management of the supply process from initial evaluation to final delivery and acceptance
- Management of supplier interaction, required for direct system interfaces
- Verification of the supplier deliveries for technical and contractual completeness



System safety

Saab performs system safety tasks according to international (MIL-STD-882) or national standards. Safety assurance on a combat system level will include the management and

coordination of underlying safety protocols, radiation hazard (RADHAZ) analysis, weapons safety, as well as any other hazards posing risks to life.

Cyber security – information security beyond IT

Modern cyber space has made it evident – software contains vulnerabilities just waiting to be exploited. Why risk cheap, effective and non-attributable attacks on your valuable assets? At Saab, we continuously develop our cyber security capabilities to support customers and partners in identifying, understanding and mitigating vulnerabilities throughout the entire system life cycle, from early design to operational systems management to decommissioning.

A chain of automated tools help finding vulnerabilities and preventing attacks, from the development environment and integration, into the operational 9LV system, and the same rigorous governance is applied at Saab as in the operational context.

As expected, Saab continues the tradition of striking performance and balanced solutions all the way into the cyber battlefield.

Performance engineering

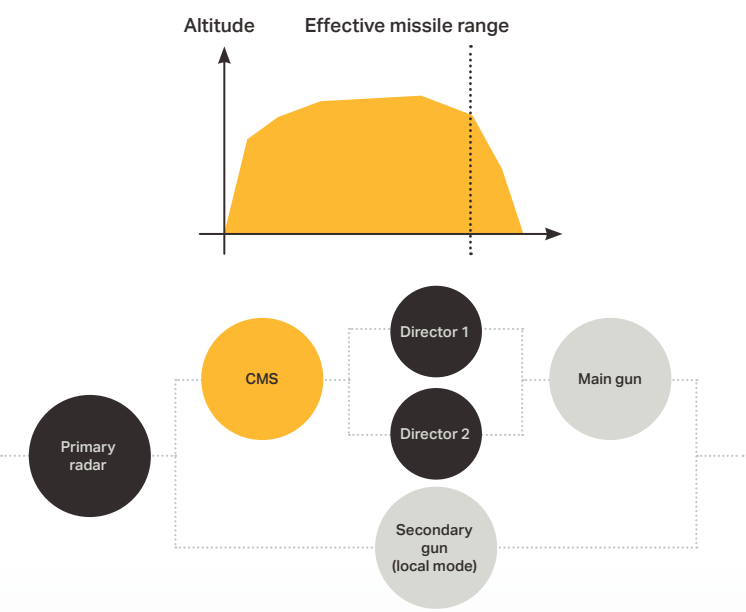
Producing a combat system requires many different types of performance engineering, such as calculating performance for radar, sonar, communication and weapon systems. Engineering analysis includes system and sub-system RAMT and LCC.

Saab has specific expertise in kill chain analysis, with experience in pairing a wide variety of sensors and effectors.

Interface engineering

Interface engineering involves obtaining and establishing all interface documents and drawings needed for problem-free integration of individual systems into a proven, working combat system for a specific ship.

Saab has interfaced most types of sensors and weapons used by any combat systems.



Examples of integrated equipment:

- Radar systems including multi-function radars
- EW suites (ESM/ECM/jammers)
- IFF
- Decoy launching systems
- Laser warning systems
- Electro-optical systems
- Tracking devices
- Missile launchers
- Surface-to-surface missiles
- Surface-to-air missiles
- Large and small calibre guns
- Sonar systems
- Torpedo launching systems
- Tactical data links
- Sensor/UxV links
- Navigation equipment
- Communications equipment and systems



Top deck design

Combat systems typically comprise high power emitters, sensitive sensors and complex weapon systems. Fitting different combat system equipment into the limited space available on top of a naval ship, without causing subsystem mutual interference, requires careful analysis.

In cooperation with our partners, Saab can offer analysis and measurements supporting the top deck design effort. EMI/ EMC analysis of radio frequency emitters and receivers placed above deck is usually a part of the top deck design effort, as are lightning protection measures.



Combat Information Centre design

An important aspect of the usability of a combat system is the design and layout of the heart of a ship, the Combat Information Centre (CIC). Saab can take complete responsibility for designing a CIC tailored to the intended missions and selected capabilities of the ship. Layout and fitting suggestions can also be provided for other types of spaces, such as those intended for combat system equipment.



Combat System **Integration**

Combat System Integration takes the installed combat system elements and integrates them into a system where performance meets the required specifications and is ready for harbour and sea acceptance testing.

Pre-delivery interface testing of the system's elements, testing of the combat system integrated within a land-based test site and performance verification of portions of the combat system can all be performed during the CSI phase.

Saab is experienced in setting up suitable tailored integration environments as well as planning, preparing, coordinating and executing integration tasks. The process can include the use of shore-based reference sites, land-based test sites, specialised test facilities and on-board ship integration. Integration of the different elements of a combat system can be performed in many ways and at several locations simultaneously.

Integration is a complex task. It includes obtaining installation data, creating detailed compartment designs, reviewing installation procedures, performing installation checkouts and many other tasks.

Saab can assist you with the different activities involved in ensuring that the combat system equipment is compatible with the ship platform.

Platform integration services

Prime for upgrade or new-build

Saab can provide platform integration services in prime roles to a shipyard for both upgrade and new-build platforms. Integrating a new combat system to an existing platform requires detailed knowledge of the platform's capabilities and capacities, as well as the ability to match them with the platform services required by the new combat system.

Modifications to both platform capabilities and combat system design may be required to achieve cost-effective integration of a new combat system with an existing platform.

Upgrades to or refurbishment of existing platform systems may also be required to ensure maximum performance. Saab can advise you on the required scope and nature of these refurbishments.

Workspace design

Work environments for operators are an important consideration in the combat system integration. Saab can assist in the design of working spaces to ensure optimum environmental conditions for operators.

Combat System harbour and sea acceptance testing

The harbour and sea acceptance testing of a combat system and its elements can be a significant part of the overall testing of the complete ship. Saab can provide support to a shipyard or a prime in planning, scheduling, preparing, orchestrating and executing harbour and sea acceptance testing. Tasks include compiling or reviewing acceptance test procedures and supervising or participating in testing. Dedicated teams are normally assembled for this task.

Before acceptance testing, some combat system elements needs to be aligned and data entered into concerned systems. Saab has the processes and equipment for both static and dynamic alignment.



Standard engineering services

Saab has considerable experience from a number of projects of various sizes and scope and is thus able to offer a number of standard service packages. These packages include typical CSE and CSI services as required for man new-build or upgrade projects. A high-level view of commonly used packages is given in the diagram below.

TASK	ENGINEERING SERVICES			
	Basic CSE/CSI	Extended CSE/CSI	STW, HAT, SAT	Subsystems
CS project management	●			
Operational concepts		●		
CS requirements	●			
CS architecture/design	●			
Performance engineering, including logistics engineering	●			
Interface engineering	●			
System safety	●			
System acquisition				●
Factory acceptance testing (FAT)				●
System integration service	●			
Platform integration services	●			
Support with top deck design		●		
Support with compartment layout		●		
EMI/EMC services		●		
STW planning coordination			●	
Harbour and sea acceptance testing (HAT/SAT)			●	
ILS coordination		●		
CS technology transfer		●		

- KEY
- Standard task
 - Standard task, variable scope
 - Independent option

Continuous engineering – because reality never sleeps

The future of combat systems

In a world where development cycles accelerates and new technological advances and new doctrines surfaces at a rapid pace, the traditional ways of handling the life cycle effectiveness will change. Naval ships and their combat systems must leave the traditional newbuild – midlife upgrade – decommissioning cycle and move into incremental change, or a continuous engineering approach. The combat system will as everything else, have to deal with constant development and its consequences. If the procurement, design and build process of a complex ship takes ten years, imagine the development of unmanned warfare during this period.

The 9LV combat system open architecture and modular design is very well suited for continuous engineering and is already under contract with these new principles. This also requires a closer cooperation, where procurement offices, end users and suppliers need to shorten their own OODA-loops and work closely together – a leading star for Saab. Continuous engineering with regular updates on both combat system and on ship levels will deliver the up-to-date performance needed on the front line.

The CMS with its infrastructure will keep its prime role as an integration hub and provider of cyber security. It will act as the key to cooperative engagement, developing optimisation, shorter decision loops, shared pictures and assisting in man in-, man on- and man out of the loop designs and functionalities.

Next generation workspace

As a visible step towards tomorrow, Saab has developed a concept Multi-Functional Console, a **Future Operator Workspace**, the FOW. It is truly operator centric, taking into account the increasing burden of our future operators. It seamlessly integrates human-centred design and ergonomics, with a sophisticated user-machine interface – setting new standards in human-machine interaction and battlespace management.

Academia has been involved as well as gamers and a few experienced old-timers. We have learnt a lot on how to shorten operator cycles, increase human endurance in a stressed environment and how to interact with the ever-increasing flow of information. The FOW provides a clear and distinct presentation of the tactical and operational environment, optimising the operators' ability to process complex cognitive decisions at an instant. It reduces operator mental load and fatigue, and enable increased reaction times, saving valuable seconds in critical situations. The black beauty has been very well received and much of the feedback and lessons learnt will be built in turning the concept into product.

We welcome you to follow the journey on the Saab channels.



Addressing the drone challenge

Drones have quickly become an increasingly vital resource in military operations and are used for everything from surveillance, reconnaissance and communications to tactical weapons operations. Drones not only create new opportunities and capabilities. They also create a range of new threats, many of which are difficult for traditional sensor solutions to detect, track and classify. A prime sensor with drone detection capability, like the Saab Sea Giraffe series, is a good start, but there is more to it than the first detection.

The 9LV Combat System offers integration and optimisation of a range of subsystems, that together will present a well-balanced anti-drone functional chain, from detection by multiple sensors to classification and engagement with suitable effectors.

Engaging a single detected drone is a relatively simple measure, whilst a swarm of drones may require a more complicated solution. One method is to orchestrate a volume engagement, where the 9LV CMS is used to lightning fast optimise the available weapon channels according to the incoming threat.

Drones may also constitute a potent threat in harbour, often already in peacetime. A 9LV combat system will make the necessary subsystems available also in a low manning harbour scenario, where even mobile sensors and effectors can be interconnected for a complete functional chain.

Sub-systems and products

CEROS 200



The **CEROS 200** is a stabilised radar and optronic system providing all-weather target tracking for naval ships. Working in combination with missile and gun systems it provides excellent defence against any threat, including advanced sea-skimming missiles and asymmetric surface threats. Especially in littoral environments.

The system features world-class acquisition speed and tracking precision. It has the ability to track any target, including supersonic missiles and surface threats, in any weather conditions over long and short distances. It also features options for tracking multiple targets as well as the ability to seamlessly switch designation of the primary target.

The CEROS 200 is available in a CWI configuration with the 9LV ESSM Missile Control Module. It provides an X-band channel for CWI target illumination enabling guidance of the semi-active surface-to-air missile.

Patented CHASE algorithm

Low-altitude threats such as sea-skimming missiles are traditionally hard to detect and track due to multipath interference. The CEROS 200 uses the CHASE algorithm to eliminate this problem, ensuring target tracking even when there is interference.

The top weight is 630–750 kg, much lighter than comparable systems, which makes it easy to integrate with all platform types. Highly resistant to the latest jamming technology, the CEROS 200 provides reliable performance even in cluttered environments. The system can also be combined with the 9LV Gun Fire Control and SAM modules, providing precision control for any naval gun or a semi-active SAM missile system.

Key strengths:

- **Extremely high accuracy**
- **Fast reaction**
- **High availability**
- **Patented CHASE algorithm**

Benefits:

- **Accurate low-altitude tracking**
- **Enables efficient firing with fewer rounds**
- **No need for an additional radar**
- **No reliance on EO sensors**

EOS 500



The **EOS 500** is a smart sensor system capable of performing high-accuracy 3D tracking and surveillance.

It is well suited for tracking visible air or surface targets, surveillance tasks like identification or supporting search and rescue operations, and it uses a number of automatic functions to reduce the operator's workload.

The EOS 500 features some of the most capable sensors on the market, housed within an electrically stabilised pedestal. It comprises one TV and one thermal imager, as well as a high pulse repetition frequency (PRF) laser range finder. It can lock onto and track air targets and, if needed, quickly switch between them.

Combined with the 9LV Gun Fire Control Module, the EOS 500 provides precise anti-air and anti-surface engagement for any naval gun. Weighing only 120 kg, it is easy to integrate into a wide range of platforms, with an open design that enables straightforward future sensor upgrades.

Key strengths:

- **Exceptional stabilisation performance**
- **Low weight**
- **Low profile**
- **Easy maintenance**

Target Designator



No matter how robust your sensors are, it is vital to have comprehensive redundancy functionality to ensure the security of your forces and assets.

For this reason, Saab's 9LV FCS includes **target designators**, used by lookouts for direct optical designation of targets.

By using two designators, one for starboard and one for port, the installations are not restricted to those few areas on board where 360 degrees of free sight is possible.

The target designators are suitable for use during the day or night and are equipped with an Aimpoint device for red dot targeting. An optional image intensifier enhances night capability.

The designators feature two push buttons, the first of which is used for designation in bearing and elevation to the FCS. The second button allows the lookout to take immediate control of the director, starting an acquisition process.

Multi-Function Consoles (MFC's)



Saab's 9LV MFC's are designed to be adaptable to different customer needs and requirements. Developed with the operator in focus they provide both ergonomic and operational excellence, and thanks to the ultra- high resolution wide screen display(s) the tactical picture presentation is extremely clear and distinct. This together with the quick and logical human computer interaction concept makes the 9LV MFC's most suitable for all types of naval applications. Our MFC's can display any combination of tactical information e.g. TV/IR-video, sonar video, overlaid pictures and satellite images as well as S57 charts and overlaid raw radar, both in 2D and in 3D.

The 9LV MFC's is part of Saab's 9LV modular suite of solutions for Command and Control in Naval Environments and aligned with Open Architecture compliant Combat Management Systems. This modularity allows Saab's MFC's to be provided as an optimally integrated part of the 9LV Combat Management Systems, or as a stand-alone product with optional 9LV software modules.

Key strengths:

- **Excellent ergonomics**
- **Modular design**
- **Based on COTS**
- **Quick access with Touch Input Display (TID)**

TactiCall integrated communication



TactiCall integrated into a 9LV console using a touch display.

TactiCall Integrated Communications Solution

interconnects all your communication technologies regardless of radio band, frequency or hardware, reduces effort, lowers risk and increases pace. The system is scalable from one to several operator positions or communication interfaces and makes up the centerpiece in remote-controlled setups from single radio to complete operations.

TactiCall allows you to provide the functionality needed to support your operational requirements spot on and integrate seamlessly with third party equipment, legacy as well as new. The intuitive user interface guarantees secure and reliable operations within every operational setup, be it within international or joint coalitions, own force squadrons or single ship operations.

TactiCall is a robust and highly survivable system with no single point of failure, which will let you handle voice- and data communication, red as well as black, in a fast and efficient manner.

Training for mission success

Saab supports forces and units with simulation and training expertise throughout the training life cycle. Our focus is realistic and efficient training solutions that create true training value.

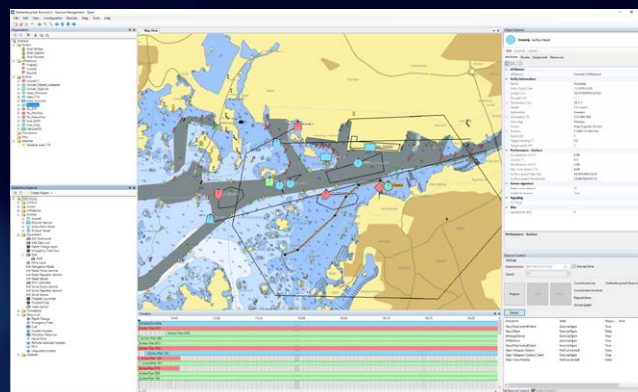


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We offer a set of applications for training of different roles at the Combat Management System as well as the Fire Control System – from the individual operator to complete team training and all the way to joint training operations. Multiple teams can create realistic training scenarios – to train as you fight – by connecting several Combat Information Centres or teams.

The training applications are embedded onboard or stand-alone in a land-based facility. They may be combined in different ways using Saab's integrated training environment and managed through our joint game management applications. The onboard applications can be utilised in parallel with ship operations thanks to a separate simulation network.

Saab can provide all necessary equipment, tools and knowledge required for providing a complete naval training service.



Training applications

Ship protection training

A full Live training capability with e.g. weapon or RHIB instrumentation – may also be combined with virtual or constructive solutions for full-scale training.

C4 training

Training command & control methodology without the need of a full-scale operational Combat Management System.

CMS training

Realistic training at the Combat Management System that features a built-in simulation function that supports command team training and provides an experience almost identical to live operations.

FCS training

Authentic training at the Fire Control System where sensors and weapons are simulated to provide an experience almost identical to live operations – from detection to engagement.

Weapon training

Realistic live instrumented training as well as virtual training on desktops or mock-ups.

Sonar training

Training for the sonar operator in realistic environments.

Comms training

Training in the use of COMMS in a synthetic environment and linking it with other operational environments.

Nav training

A complete bridge simulator.

Long-term support

Supporting excellence

Our support services have one clear goal – to make sure your 9LV system provides unparalleled availability. With services tailored for every stage of the system’s lifecycle, you ensure operational excellence and create the confidence that comes from knowing that whatever lies ahead, your 9LV system is ready to act and deliver the striking performance required.

Defining a Support Agreement

The main purpose is to establish a mechanism between the customer and Saab for maintaining system performance as well as system knowledge within the customer organisation or according to customer maintenance philosophy. Usually, a support agreement comes into force by the time for expiry of the warranty and is valid up to decommissioning of the vessel.

A Support Agreement within long-term support is defined by customer specific operational requirements, system availability and existing maintenance organisation. It outlines the parameters for long-term support and is an efficient channel for the interaction between the customer and Saab.

A Support Agreement normally includes the following services:

Help desk support

The Saab help desk function provides technical and operational support and is coordinated by an assigned Project Manager who handles any upcoming question or inquiry.

Customer conferences

Depending on the number of 9LV systems or vessels in operation, recurrent yearly meetings between the assigned Saab team and the customer will take place where information and experiences will be exchanged.

System plans

In order to keep the 9LV system up-to-date over time, Saab will periodically notify the customer about any available hardware or software upgrades. Logistic Engineering calculations will be made accordingly in order to verify the actual requirement of spare parts, reflecting the current system configuration..

Provision of spare parts and repairs service

Naval systems are continuously exposed to harsh weather, temperature, humidity and physical strain which inevitably lead to the need for Spare Parts. Provision of Spare Parts, identical with the system delivery or equivalents, will be provided during the entire system lifetime. Equally important is provision of swift and effective repair services. Saab will repair faulty parts at our own premises or can organise a subcontractor under the supervision of our quality assurance

organisation. In parallel, Saab will establish and maintain a fault history archive in order to capture usage, failure and corrective action data: information that is shared with the customer by providing a yearly failure report.

Software support

Provision of Software Support services can be provided, facilitating smooth modifications or changes within the operational software. Functionality upgrades, interface changes or cyber security are standard reasons for software modifications, as well as more customer specific requests. Software changes are provided using a reference system where the current software version is running and from where changes reflecting a new configuration are made. The reference system is used for an adequate verification once the implementation is made. Reference systems are normally situated at Saab’s premises but can also be located at the close to the customer or end user.

Technical support on site

Saab’s responsibility for a solution does not end after a completed and approved installation. A Support Agreement normally includes several predefined visits of skilled support engineers or in-country support executed by a permanent residential engineer from Saab.

Obsolescence management

Obsolescence monitoring and management is an important undertaking within a Support Agreement. In the event of a component approaching obsolescence, Saab will notify the customer with a suggestion for component stockpiling and/or replacement.

Training and documentation

Saab provides secondary operational or maintenance training at the customer’s premises, securing transfer of vital knowledge to new technicians and operators. Training can also be conducted as On-The-Job-Training (OTJT), which is more of “hands-on” training on-board, made by Saab’s well-experienced service engineers. During any training, the system documentation is important and used to provide each user with the information they need to operate and maintain the system. Upon request, Saab can provide uniquely adapted documentation that reflects an individual customer’s day-to-day use of the system.

		SERVICE LEVEL EXAMPLES			
SERVICES	SERVICE BLOCK	1	2	3	4
Management	Point of Contact	●	●		
	Service Management		●	●	●
Engineering	Configuration Management		●	●	●
	Obsolescence Monitoring		●		
	Contractor Obsolescence Management			●	●
	Engineering Investigations (PDS task)		●	●	●
	Service Desk		●	●	●
Maintenance	Accesses to Saab Spare Part Tool			●	●
	OEM Repairs (Depot level)		●	●	●
	On-Site support / Assistance		●	●	●
	Resources, means and infrastructure		●	●	●
Supply	Spare Part Supply		●	●	●
	Measures for requested lead times		●	●	●
Training	Training		●	●	●
		KEY			
		● Always available			
		● According to support agreement			
		● Optional			



Extending the lifecycle

Modern naval vessels have a life expectancy time exceeding 25 years. To ensure continuous development during this time, Saab provides long-term technical support. This includes the provision of spare parts and repairs on top of a variety of services in order to improve reliability, availability, maintainability and testability throughout the system’s operational lifecycle.

Extending the system lifetime can be made through overhaul of an existing 9LV system, a complete replacement, or thirdly, a mixture of overhauling the

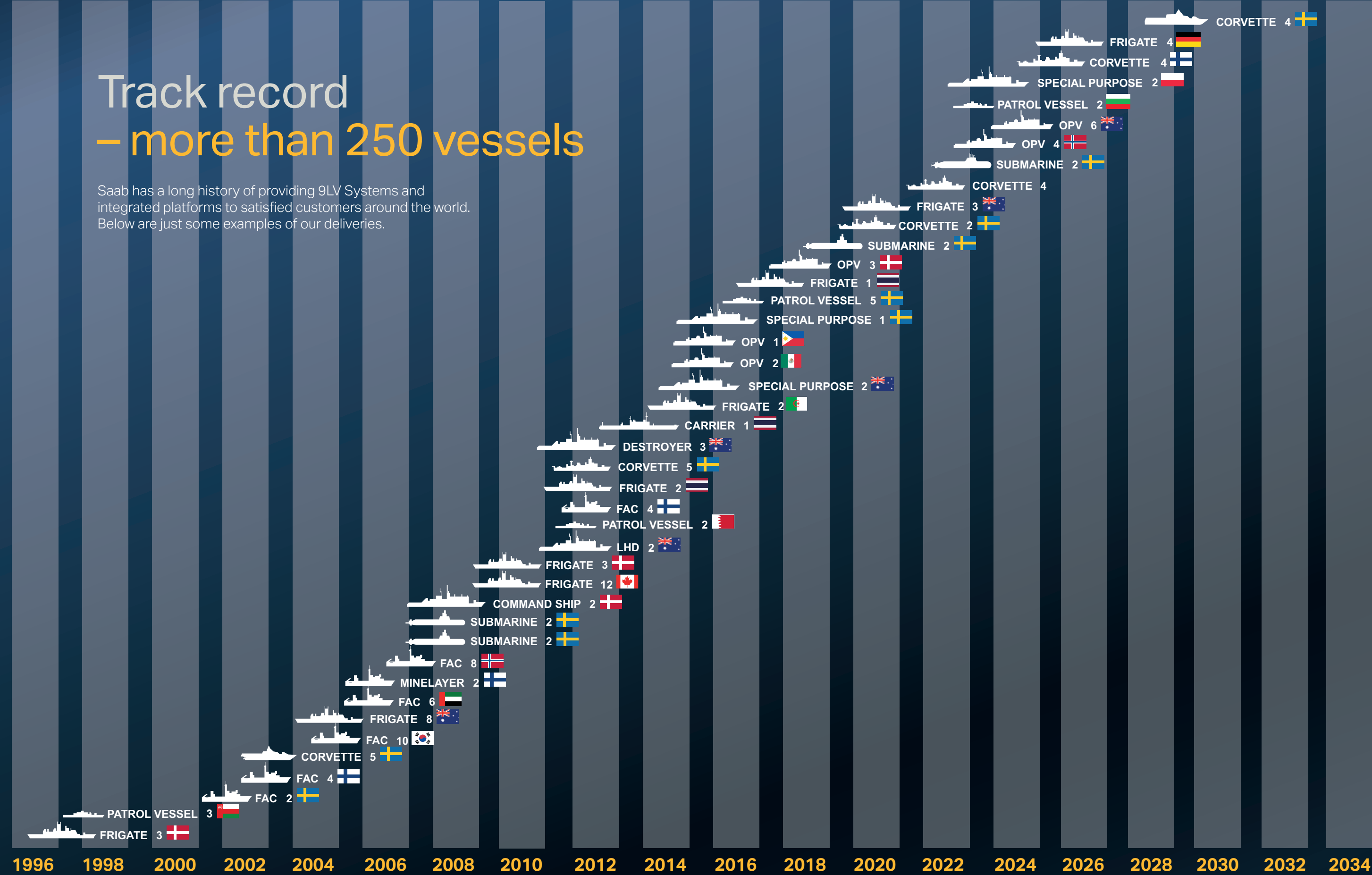
current system and integrating 9LV parts from the latest generation. Recommissioning and reusing well-maintained 9LV parts on board new commissioned vessels is another option. The choice is yours!

Many of our systems are hardware independent, meaning parts can be easily interchanged, thus minimising end-of-life problems.

Track record

– more than 250 vessels

Saab has a long history of providing 9LV Systems and integrated platforms to satisfied customers around the world. Below are just some examples of our deliveries.



Working with Saab

The true needs of the navy

Saab's broad experience in the naval domain has made us a trusted partner for many navies around the world. Our customers benefit from a long-term relationship with support at every stage, from the early phases where ideas are captured, to the shaping of tailored solutions, through to maintenance and upgrade planning. As a Combat Systems provider, Saab recognises that the key to long-term success is understanding the true needs of the end user.

A flexible global partner

In order to provide the best possible solutions for our customers, Saab works with leading companies in the naval domain, often forming long-term relationships based on the supply of outstanding products. Saab can take a leading role, or work as a sub-supplier, depending on the situation.

Our products and business models are designed for partnership and lead to flexible teamwork options where both Saab and our partners become part of a winning team.

Local presence, local partnerships

Saab recognises local presence as an increasingly crucial factor for success. This makes it important to be established locally, build local competence and understand local conditions. Today, Saab has a local presence in more than 30 countries and sales in over 100.

Saab cooperates with local industry and forms partnerships to better meet and understand local conditions. Our local partnership approach is tailored based on a balance of all contributing factors to form an optimal and sustainable solution that is successful during and after the initial project. Existing skills are incorporated and enhanced throughout projects where Saab addresses the needs of product adaptation and in-country support.

» Saab is a dedicated and trusted supplier of naval combat systems.

You can rely on Saab's thinking edge to deliver innovative, effective products and solutions that enhance your capabilities and deliver smarter outcomes.

Doc id: Saab 9LV NAVAL COMBAT SYSTEM - eng - ver. 2 - October 2024

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